Activities in Support of v6 at NOAA/NESDIS

Chris Barnet
NOAA/NESDIS/STAR
Oct. 11, 2007
AIRS Science Team Meeting
Greenbelt

(with a lot of help from NESDIS support staff (STAR & OSDPD (Tony Reale)), U.Wisc (Dave Tobin), UMBC (Larrabee Strow, Scott Hannon), JPL (G. Aumann)

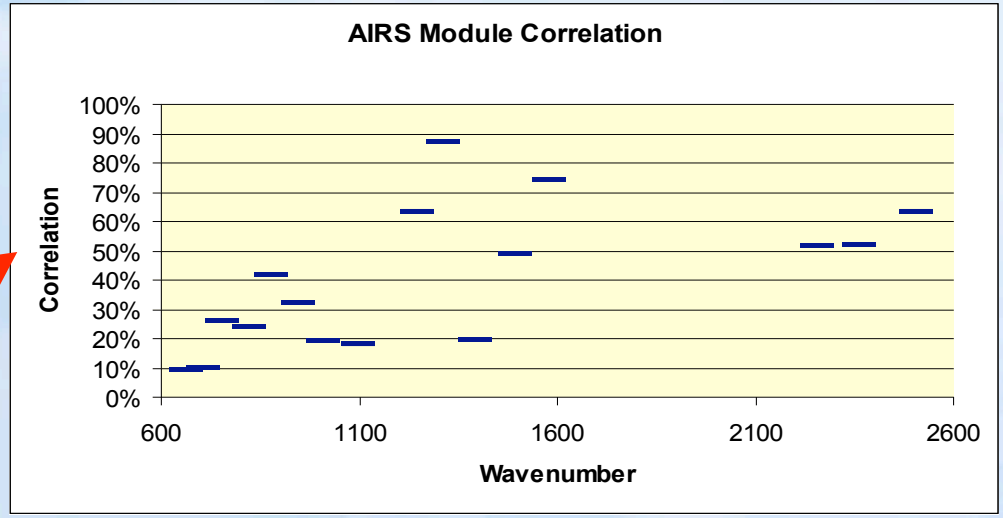
Topics

- Does AIRS spectrally correlated noise affect v5.0 level.2 product?
- Update on level.2 biases w.r.t. operational RAOB's.
- List of activities we would like to do for version 6.

AIRS Spectral Correlation

- Performed an experiment to test the impact of AIRS spectrally correlated noise on the L2 products.
- Computed error covariance matrix in a block diagonal form (correlation specified for each of the 17 modules).

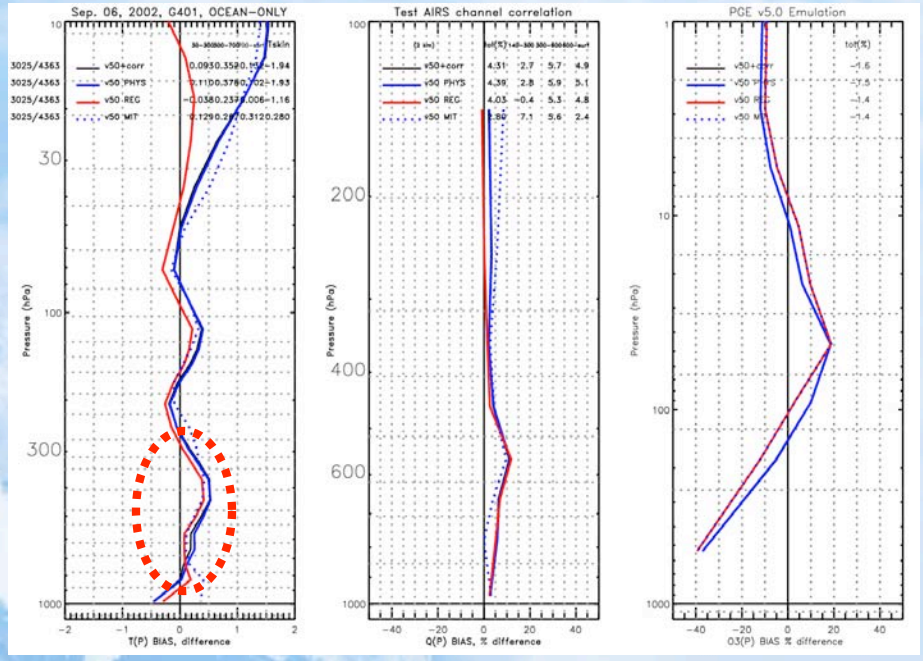
From ADFM-614
(Pagano, 2002)
C=correlated noise
T = total noise
R = C/SQRT(T^2-C^2)



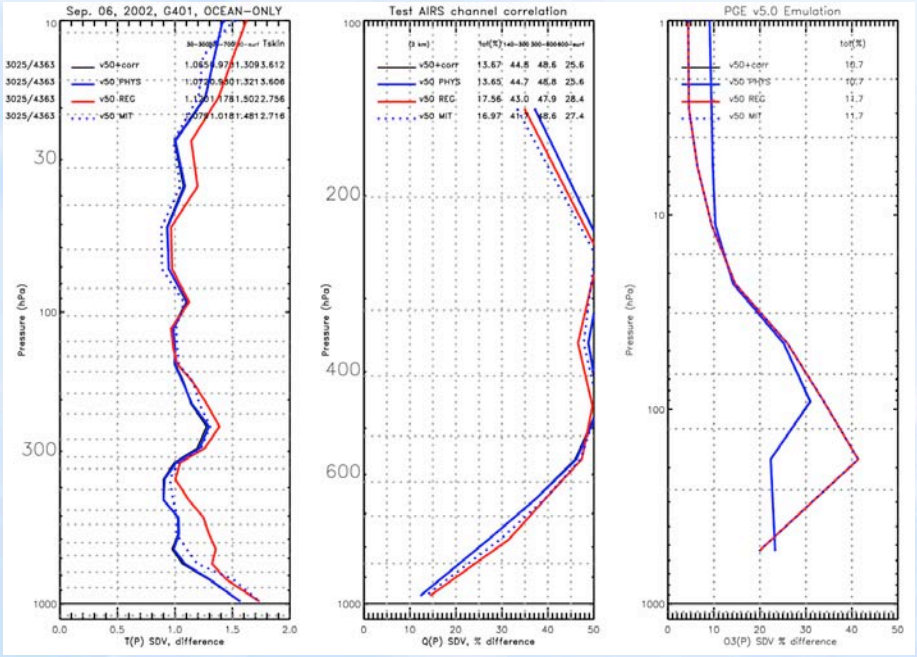
- Note that cloud clearing will reduce spectral correlation by 1/3 for clear scenes.
  - Worse case scene is a single FOV clear, all other FOV's overcast.
- Motivated by Dave Tobin's paper and conversations with Dave
  - Tobin et al. 2007 J. Appl. Remote Sensing, vol.1, doi:10.1117/1.27577071

The Good News: AIRS Spectral Correlation Does Not Impact L2

BIAS



Standard Deviation



Black Solid Line: v5.0 + AIRS correlation in all error covariance terms.

Blue Solid Line: v5.0 baseline run (with "mid trop QA")

Red Solid Line: v5.0 regression

Blue Dotted Line: v5.0 CLDY regression

Level-2 Biases w.r.t. Oper. RAOB's
Summary of Runs Shown on Following Pages

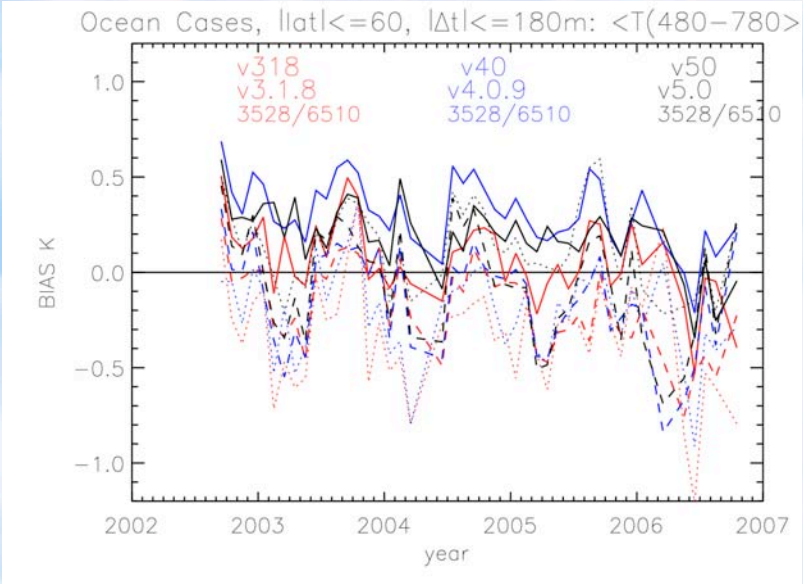
Run name	Solid line	Dashed Line	Dotted Line
V318	Final Physical	REG(CCR)	MIT
V40	Final Physical	REG(CCR)	MIT
V50 (left) V50 (right)	Final Physical	REG(CCR)	REG(CLDY)
G55 = v50 w/o REG's	Final Physical	MIT	MIT

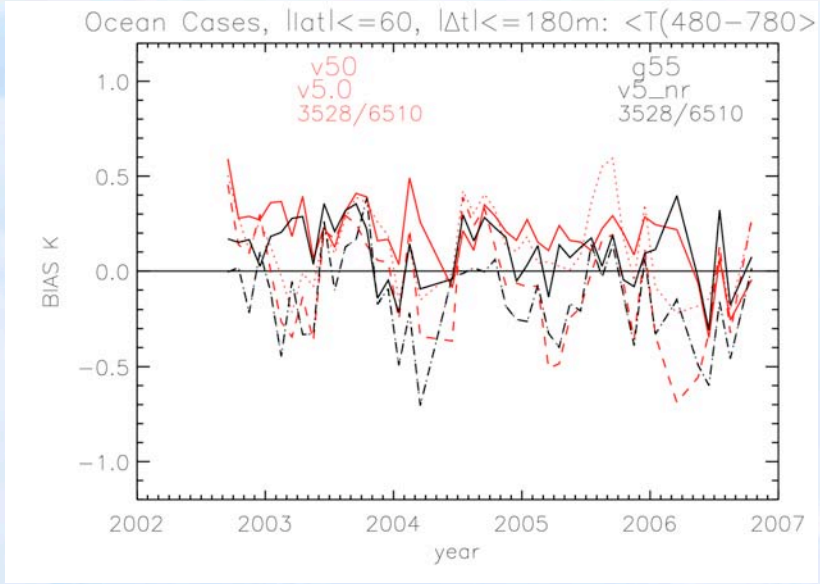
Some Details of the Analysis

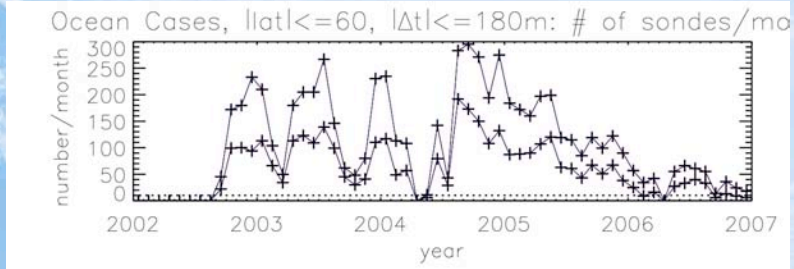
- Trends are computed as a simple linear fit to monthly averages of retrievals versus RAOBS weighted by the number of RAOB's in each month.
  - Require at least 25 sondes in a month, otherwise month is ignored.
- RAOB's have QA and only select RAOB's with the "best" sensors (per analysis by Tony Reale).
- All runs are compared on a common set of cases derived from a "v4-like" mid-trop=0 applied to v5 retrievals.
  - V3 & V4 runs accept more cases than they would have with historical QA
- Have lots of plots – NOT going to show the following, but they are part of the analysis.
  - <viewang> vs time
  - # of kicked channels vs time
  - Etc.

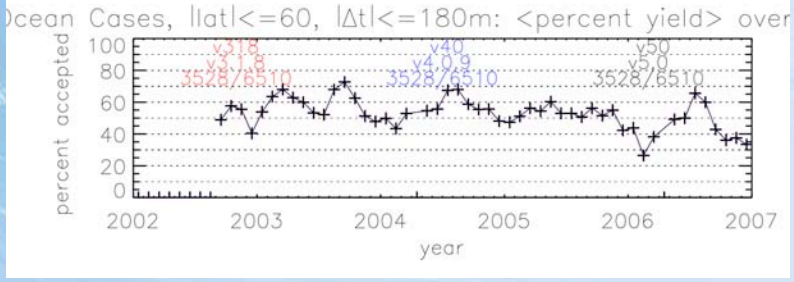
Ocean RAOB's, lat ≤ ±60, Δt ± 3 h

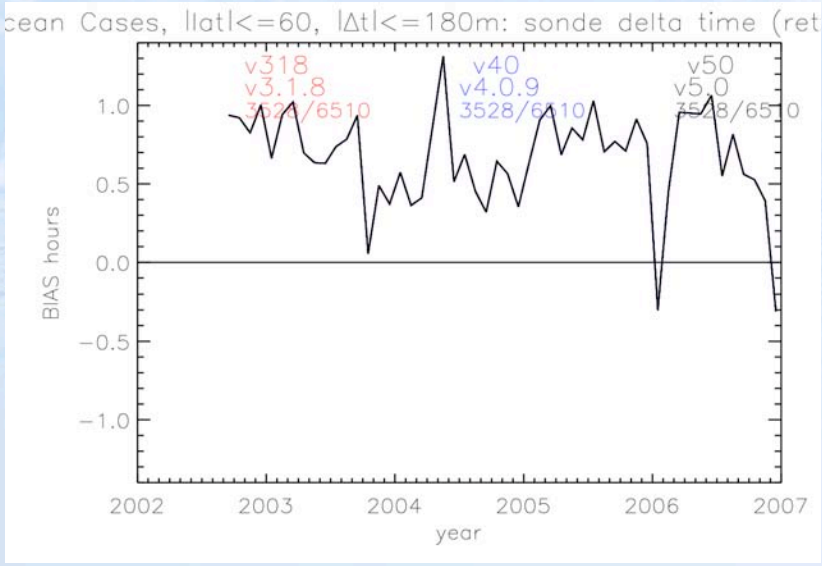
all ret's & MIT have ≈ -0.05 K/yr, CLDY REG -0.019 K/yr





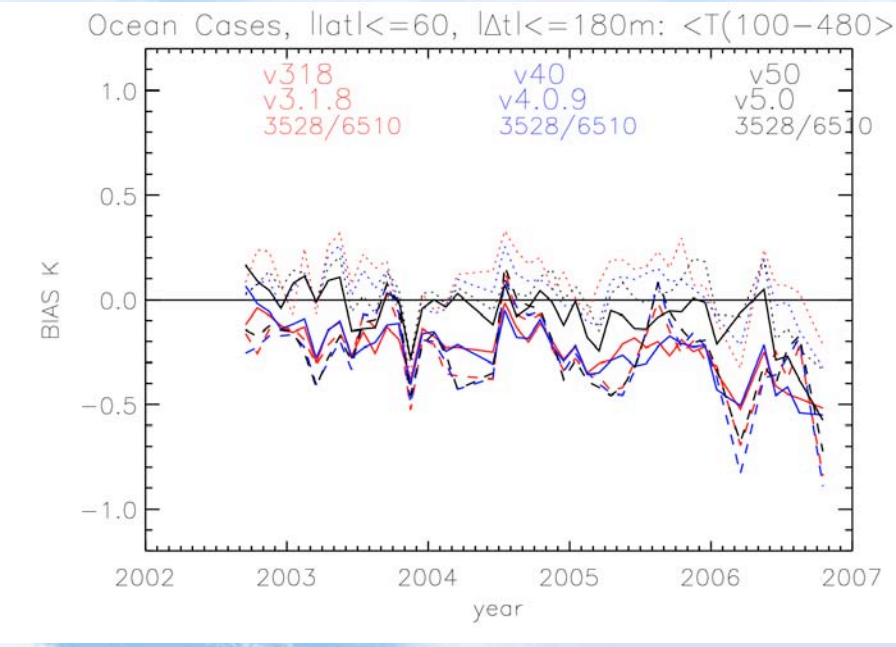


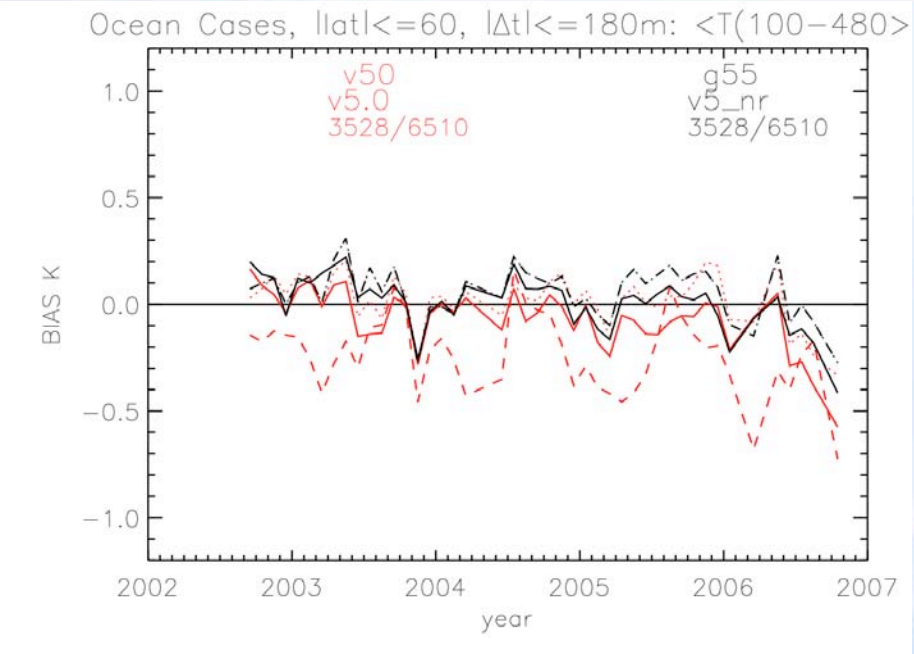




Same as before, 100-480 mb, ± 3h

ret's have ≈ -0.05 K/yr, MIT ≈ -0.01 K/yr

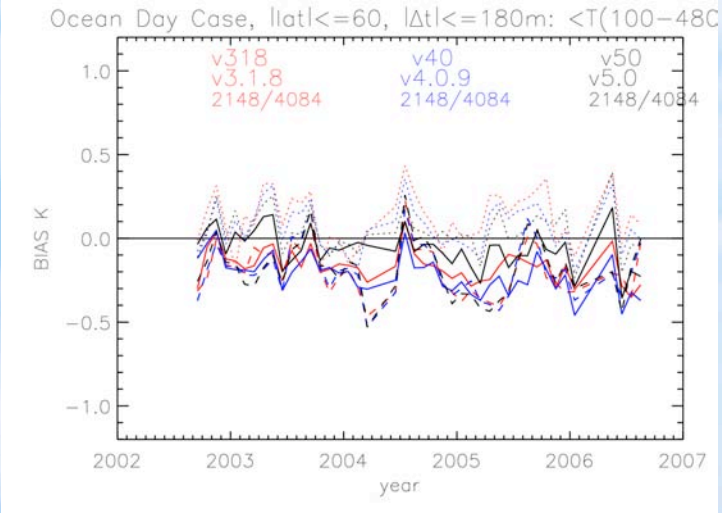


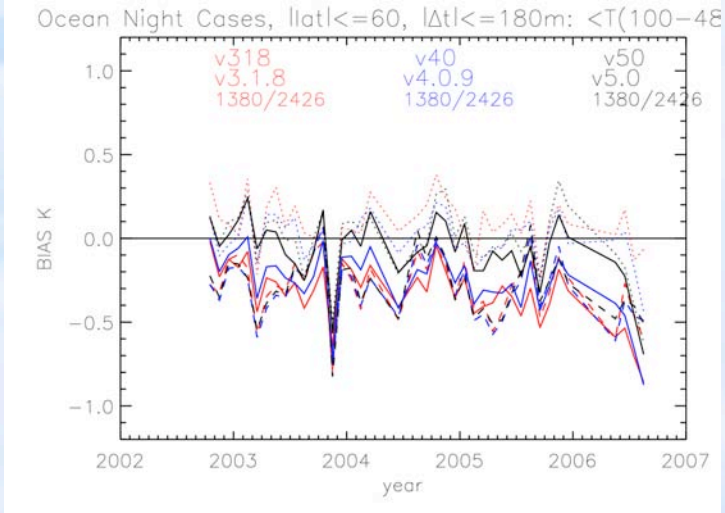


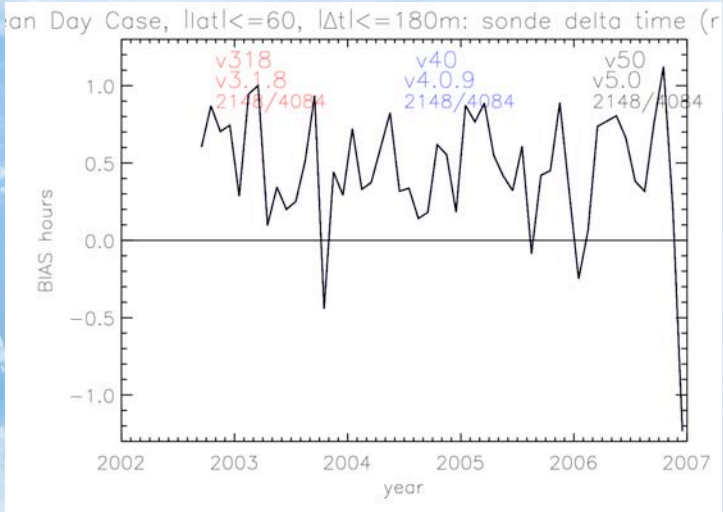
	Final <T(2004)>	Final dT/dt	"MIT" <T(2004>	"MIT" dT/dt
V318	-.207	-.053	+.128	-0.010
V40	-.216	-.062	+.055	-0.015
V50	-.055	-.045	+.039	-0.024 (CLDY)
g55	+.031	-.040	+.083	-.012

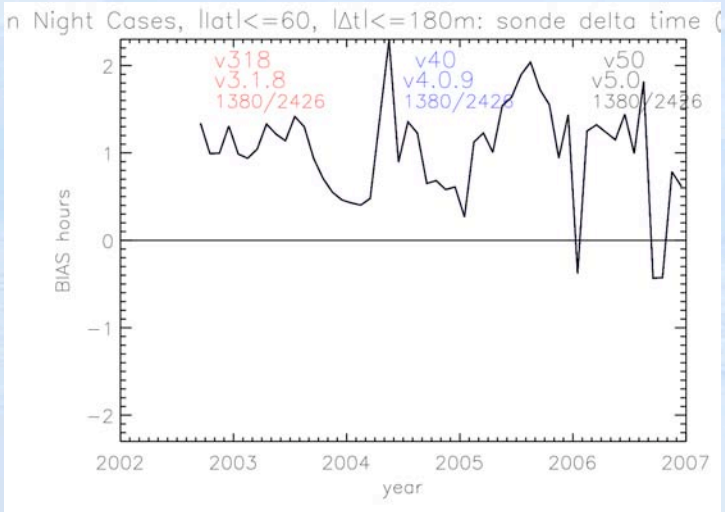
Ocean T(100-480) day & night, 3h

ret dT/dt = -.044 day, -0.026 ngt, mit/cldy ≈ -0.012







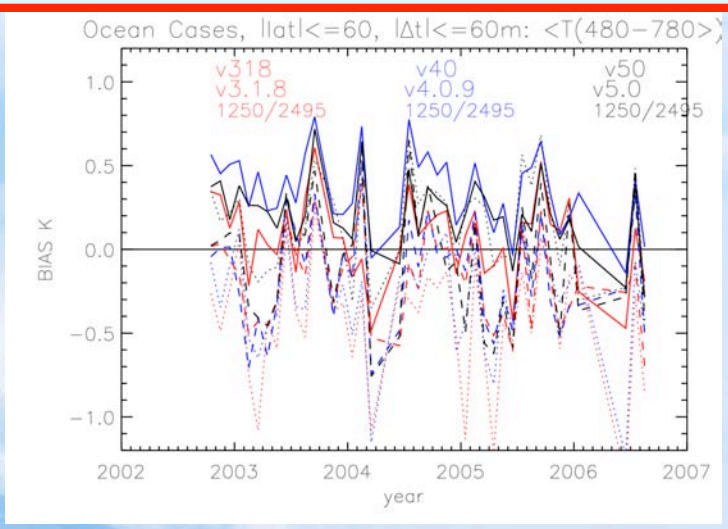


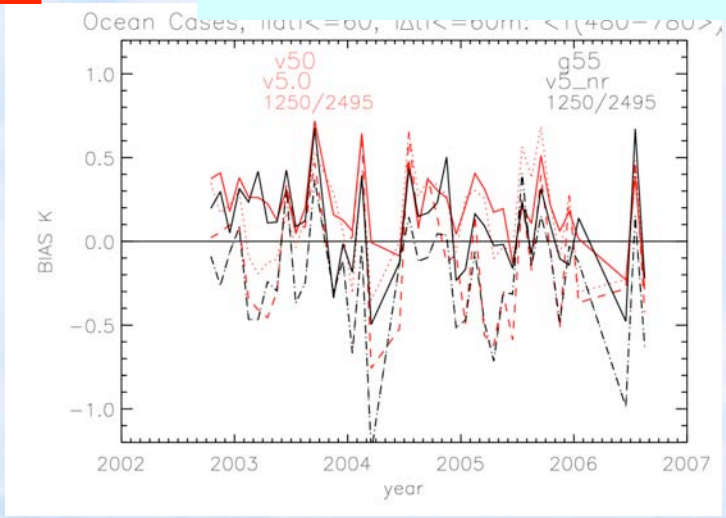
Ocean RAOB's, lat ≤ ±60, Δt ± 1 h

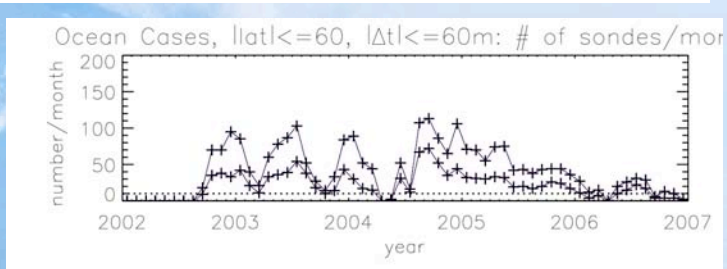
v5 MIT dT/dt = -0.6, CLDY=0.004, RET=-0.014

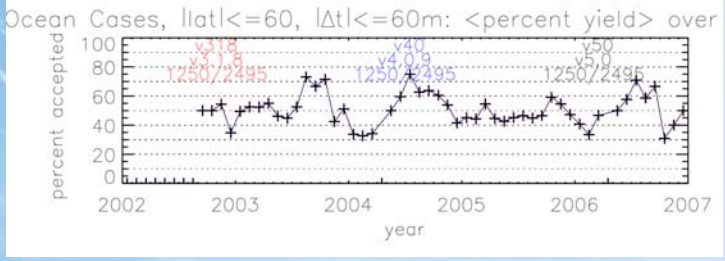
Statistically, these trends may not be significant

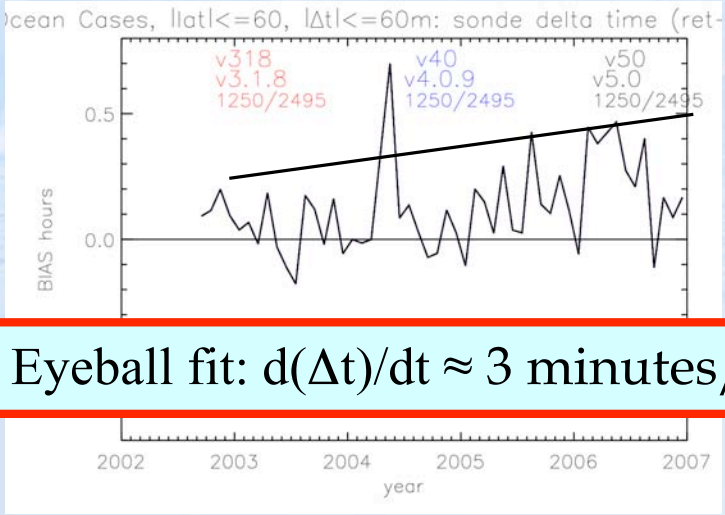
NO REG: dT/dt= -0.06 K/y







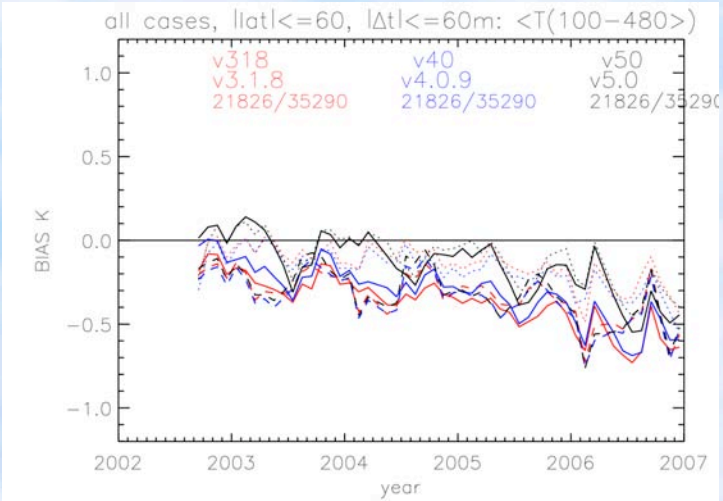


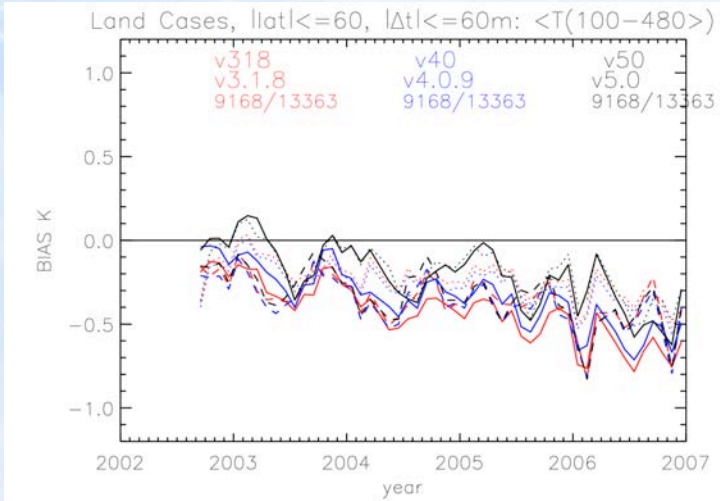


Eyeball fit: d(Δt)/dt ≈ 3 minutes/yr

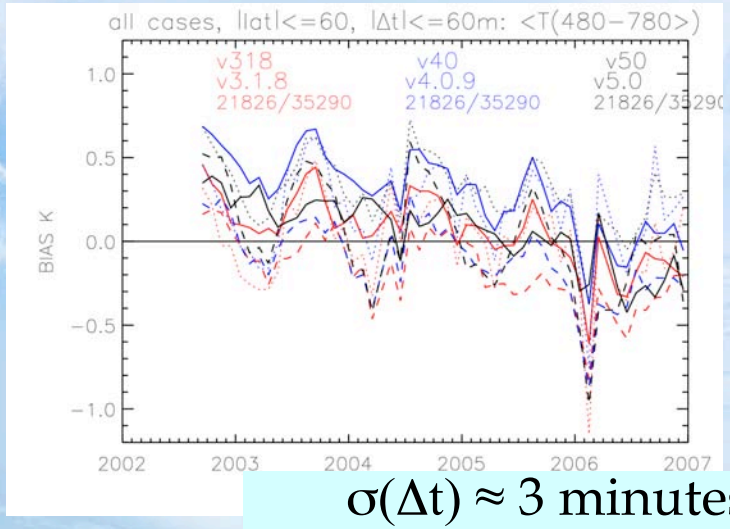
All RAOB's, lat ≤ ±60, Δt ± 1 h (most matchups we have are land)

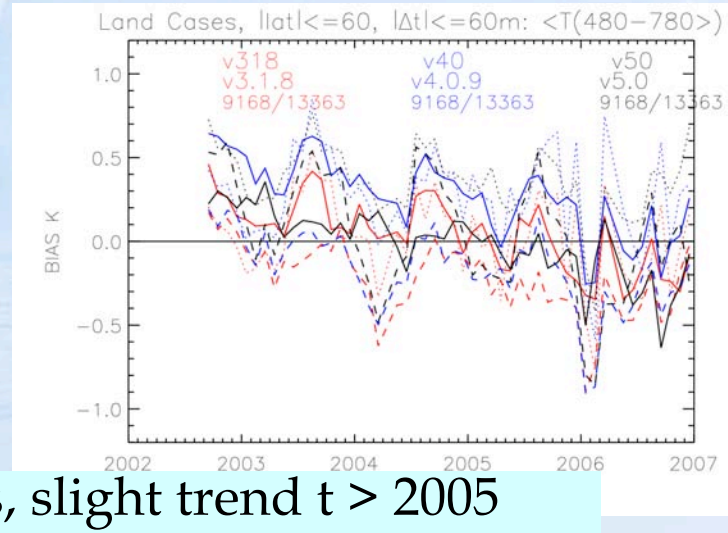
K/yr
-.097 P
-.100 P
-.080 P
-.058 C
-.057 M





K/yr
-.109 P
-.125 P
-.107 P
-.064 C
-.044 M

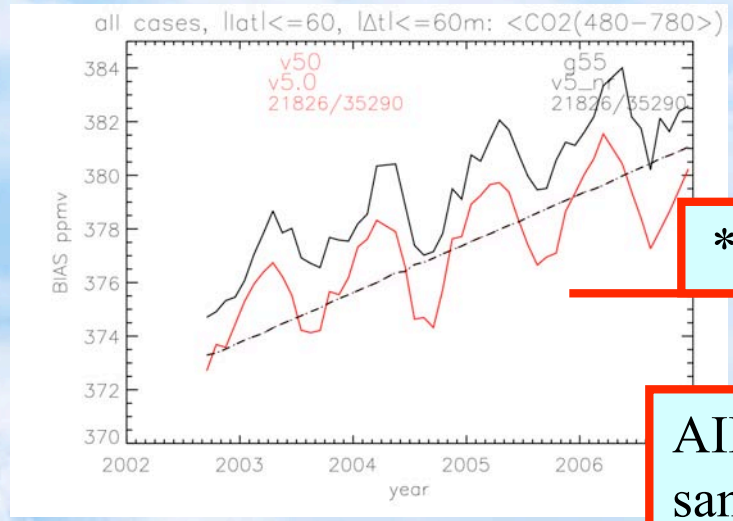


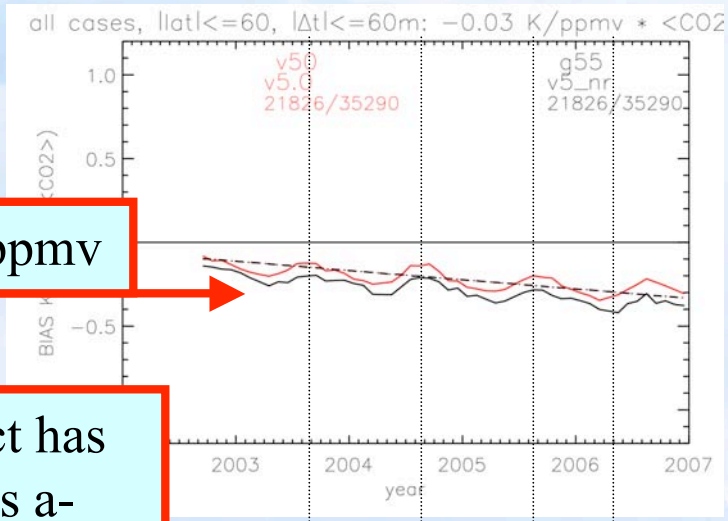


σ(Δt) ≈ 3 minutes, slight trend t > 2005

# of RAOB's decreases slightly with time

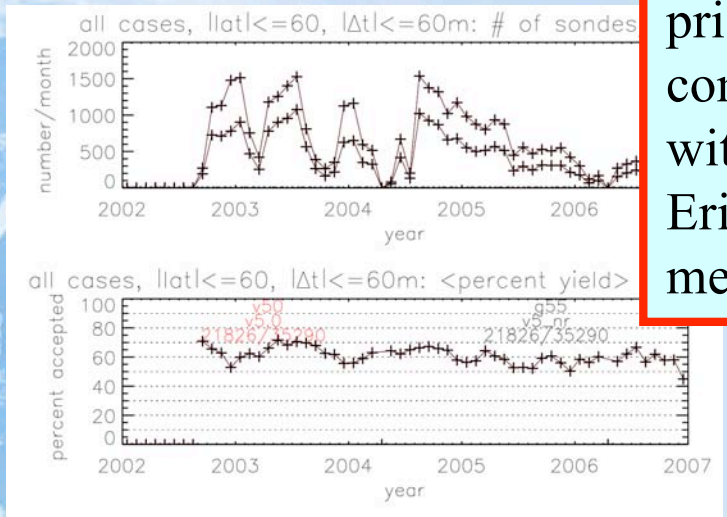
Regional CO_2 explains some of the variability, but not the overall trend

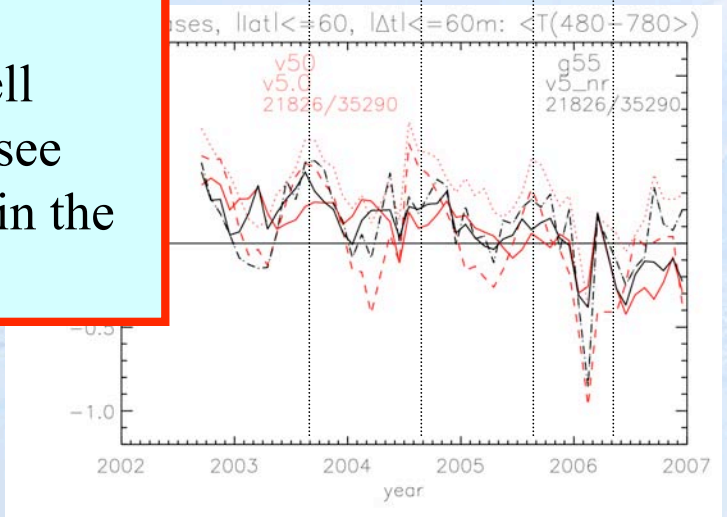




* -0.03 K/ppmv

AIRS product has same mean as a-priori and compares well with ESRL (see Eric's Talk) in the mean trend.





What Is Causing This Trend?

"I can't say as I was ever lost, but once I was bewildered for three days." Daniel Boone

- Lack of significant change in dT/dt is confusing at this time.
  - V5 has 1.84 ppmv/year CO2 a-priori, v4 was 370 ppmv, v3 was 365 ppmv
  - V3,V4,V5 had significant differences in channels used, relative weight of IR/microwave, etc.
  - G55 (v50 w/o regression) does not have any influence of training with ECMWF and is not sensitive to kicked channels (in the regression module). # of kicked channels in physical is relatively constant (v3 4→6, v4 1→4, v5 19→16→18 – water & CH4)
- What is constant among these systems:
  - ALL systems do use microwave channels to some degree.
    - Need to re-run AIRS-only system and analyse. Did it too quick before.
  - ALL systems employ local angle correction
    - NOTE: no dependence has been seen w.r.t. <viewang>
    - kicked channels?
    - Training w/ fixed CO2.
  - RAOB ensemble – maybe we have a systematic effect (other than Δt)
    - Geographic shift in the RAOB database due changes in launch frequencies.
    - Changes in sensors, relative mix of sensors in ensemble.
- We will do a run w/ regional CO2 first guess to eliminate seasonal variability
  - CarbonTracker model prior up to 2005 and extrapolate beyond that.

High Priority Activities at NOAA

- BIASES w.r.t. Operational and ARM Cart RAOB's
  - Need to understand long term bias trends
    - Closer look at trends in RAOB (ensemble attributes, RAOB-types, etc.)
    - Impact of AMSU biases on physical retrieval.
- Trace Gases: O3, CO, CO2, CH4, HNO3, N2O, SO2
  - Will work on new ozone first guess using a tropopause-relative climatology and test/compare with Laura Pan's AVE and START datasets and Wallace McMillan's INTEX
  - CO2, CH4, HNO3, N2O work will continue as long as it is practical.
  - Offered to work with Matt Watson & Fred Prada on an SO2 algorithm
  - Continue to support AIRS SO2 real-time flag & potential OMI/AIRS flag.
- Cloud clearing warmest FOV issue (next talk by Jennifer) and increasing the yield in critical and interesting cases.
- RTA upgrades, including dust RTA.
  - Improve/update radiance & transmittance tuning (with UMBC).
  - Can provide file format and interface code (wrapper).
  - CH4 tuning
- Recommendation for v6: Having CAPE, LI, and other Convective Products in STANDARD PRODUCT FILE & Level.3 would be useful.

Comments on 1x3 retrievals

- This is a *trivial* modification to the off-line code and we can *easily (i.e.,* like one afternoon) to do a quick evaluation w.r.t. ECMWF, if there is interest.
  - Code is already #FOV independent (IASI, pre-launch concern w/ AIRS that we might have to reject FOV's) – I think PGE is also.
  - Previous quick look I did in 2003 showed that 1x3 has about the same skill as the 3x3. Only looked at left/center/right difference. There were no big +/-'s
  - It obviously has the advantage that we don't need to do the local angle correction step.
  - I have never been asked to look at this, so I let it go for higher priority efforts.
- We can test this with all the validation dataset's. This is significantly more work since we included the LAC in our internal files to allow rapid re-processing.
  - Operational RAOB database – will explore this in the ret-RAOB BIAS context.
  - Gridded dataset, for evaluation of impact on trace gases this would be convenient.
  - Eric has full resolution matchups with ESRL for 2005 – we could easily do this.
- We are in discussion with SPoRT, forecasters at NOAA, and OSDPD on the possibility to providing regional AIRS (and IASI) retrievals with shorter latency and higher spatial resolution directly to NWS.
  - If there is a need (*i.e.*, formal request) this would become a VERY high priority within NOAA – right now it is NOT.
  - My conversations with local forecasters indicate this product is desirable.

High Priority Work (lots of work, very difficult to get to)

- O-E-like approach with full error propagation, no regression
  - Details discussed at the Mar. 28, 2007 science team meeting.
  - Eric Maddy is exploring concepts in the CO2 context.
  - Big advantage to all retrievals would be if T(p) and q(p) were done this way.
- Emissivity
  - Would like to test SVD methodology of Jun Li (2007GL030543)
  - MODIS first guess or use of MODIS radiances (discussed at the Mar. 7, 2007 science team meeting)
    - Use a "v5" like baseline (prior to O3 and CLDY regression changes)
    - No significant change over land
    - Concluded that cloud cleared radiance errors were dominate
    - Lack of spectral structure in MODIS product was problematic
    - Real time issues
  - Use of MODIS radiances, convolved to AIRS
    - We have MODIS "clear" pixels convolved to AIRS FOV's running in NRT.
    - These have potential value to NCEP to QA AIRS CCR's.
    - We would like to plug these into our cloud clearing and surface retrieval to provide a simultaneous solution of MODIS & AIRS radiances.
    - So far this has not generated any interest in the science team and there is no funding.

The slide was shown before, but is more relevant now. NASA funding is 8% of what it was!

"I was close to a breakthrough when the grant money ran out."